

RESULTS AND FUNCTIONAL OUTCOMES IN LOWER END RADIUS FRACTURES WITH CONVENTIONAL BRIDGING EXTERNAL FIXATOR; TIPS AND TRICKS

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Abstract

Distal radius fractures are the commonest fractures occurring in the upper extremity, accounting for 15-20% of patients treated in emergency department. Although distal radial fractures were described many years ago, they still remain as unsolved fractures with no clear guidelines. It is often reported that anatomical reduction has a bearing on the functional outcome. To study the management of distal end radius fracture by utilizing the principle of ligamentotaxis where in the reduction obtained by closed means is maintained by external fixator till solid bony union occurs. A total of 24 cases were selected for study by scrutiny of the inclusion and exclusion criteria. Most of our cases were treated with external fixator within 6 hrs of injury. Bridging ex-fix with 2 pins each in radius and 2nd metacarpal percutaneously was used for all the cases. Selective k wire fixation was done in cases of instability. Fixator was removed after 6 weeks. Guided physiotherapy was ensured in all the cases. Patients were followed up for an average of 9 months. Modified Gartland and Werley scoring system was used to evaluate the overall functional results. Excellent to good results were achieved in 88.45% of our cases while fair result was in 11.54 %. One case had pin loosening and two other cases had malunion. External fixator used for ligamentotaxis is an effective method of treating unstable extraarticular and complex intraarticular fractures of distal radius. Improved anatomical restoration with early rehabilitation has produced favourable functional outcome in our series. The complications like pin tract infection is rare due to the availability of superior

antibiotics and sterile surgical technique. Complications like wrist and finger stiffness has improved with physiotherapy.

Introduction

Distal radius fractures comprise one sixth of all fractures that present to the Trauma Care and hence significant in orthopaedic fraternity.⁽¹⁾ Distal radius fractures are the third most common fractures in osteoporotic fractures following vertebral and hip fractures.⁽²⁾ There are three main peaks of distal radial fracture occurrence. First peak is between age 5 to 14, the second in males under 50 years of age and the third peak is in females over the age of 40 years.⁽³⁻⁵⁾ There is a growing incidence of these fractures in elderly females and younger adult males.⁽⁴⁻⁶⁾ It is suggested that the two peaks represent two very different injury patterns: (1) An insufficiency fracture in elderly females indicating low velocity;⁽⁷⁾ (2) Traumatic injury in younger males indication high velocity trauma. The present study was aimed at measuring the effectiveness of external fixator in treating the complex distal end of radius fractures with respect to functional outcome, complications, ease of application and cost effectiveness.

Aim

To assess the functional outcome in distal end radius fractures treated by Ligamentotaxis (External Fixator) using the parameters like pain, deformity, radiological union, pin tract infection and range of movements at wrist.

Materials and Methods

A total of 24 patients who presented with closed/open distal end radius fractures were included in this prospective study. All the patients between 18-65 years of age with acute (<7 days) closed and open distal radius fractures are included and the patients below 18 years of age with existing deformities of forearm/wrist, patients with co-morbid conditions rendering them unfit for surgery, patients with polytrauma and Barton's Fracture were excluded.

Management

Closed distal end radius fractures were preoperatively managed by application of dorsal below elbow slab. Open fractures were managed by thorough saline and antiseptic wash followed by debridement. Primary suturing was done in clean open wounds and a plaster slab was applied. Antibiotics covering both aerobic and anaerobic microorganisms were given. Radiographs of forearm with wrist joint in postero-anterior (PA) and lateral view were taken and the fractures were

classified according to Frykman's classification⁽⁸⁾

[Table-1].Frykman's Classification

Fracture	Distal Ulnar Fracture	
	Absent	Present
Extra articular	I	II
Intra articular involving radiocarpal joint	III	IV
Intra articular involving distal radio-ulnar joint	V	VI
Intra articular involving both radiocarpal & distal radioulnar joints	VII	VIII

Instability was judged by Cooney's criteria⁽⁹⁾ namely: a) Marked dorsal comminution of distal end of radius; b) Dorsal angulation more than 20 degrees; c) Fracture involving wrist joint with articular step more than 3 mm; d) Loss of reduction with dorsal angulation more than 10 degrees and 5mm or more radial shortening after closed reduction.

Having concluded the diagnosis pre-anaesthetic check up was done and once the patient is declared fit, operative intervention was carried after explaining the details of surgery and written informed consent was taken.

Surgical Approach and Procedure

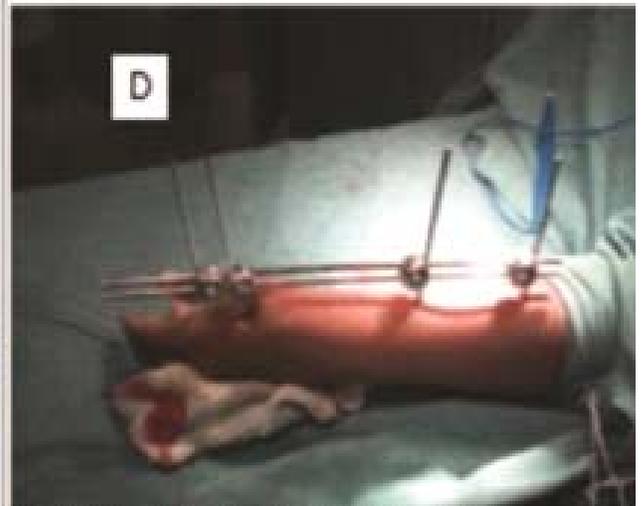
Longitudinal traction is given with elbow in 90 degrees of flexion while the fracture is being reduced with the wrist in flexion and ulnar deviation. Tissues, muscles planes were dissected till the bone is felt and care is taken to protect the radial sensory nerve. Radius is predrilled with 3.5mm drill bit in 20 degrees dorso lateral to longitudinal plane and 3.5mm schanz pins are inserted bicortically with T-handle between extensor carpi radialis longus and brevis. Index metacarpal is approached through a 2cm longitudinal incision over the dorsoradial base. The bone is predrilled with 2.5mm drill bit and then 2.5mm schanz pins are placed bicortically. Ausculap clamps were adjusted over the schanz pins through which interconnecting rods are passed. The clamps on the radial side were tightened. Holding the fracture in the reduced position, the clamps on the metacarpal side were tightened and fixed. The reduction is confirmed by fluoroscopy. K-wires were used for supplementary fixation of distal radio-ulnar instability or for Radial styloid fragment. Criteria for acceptability of fracture reduction as enumerated in [Table-2] were followed.

[Table-2]: Criteria for acceptable reduction.

Parameter	Normal value	Acceptable limit
Radial inclination	22 degrees	15 degrees or more
Radial height	11mm	6mm (<5 mm shortening)
Dorsal/Volar angulation	11 degrees Volar	15 degrees dorsal, 20 degrees Volar
Articular congruity	Congruous	< 2mm gap or step off

[Fig-1]:

Sequential intra-op clinical photographs showing the procedure of application of bridging external fixator.



Postoperative Protocol

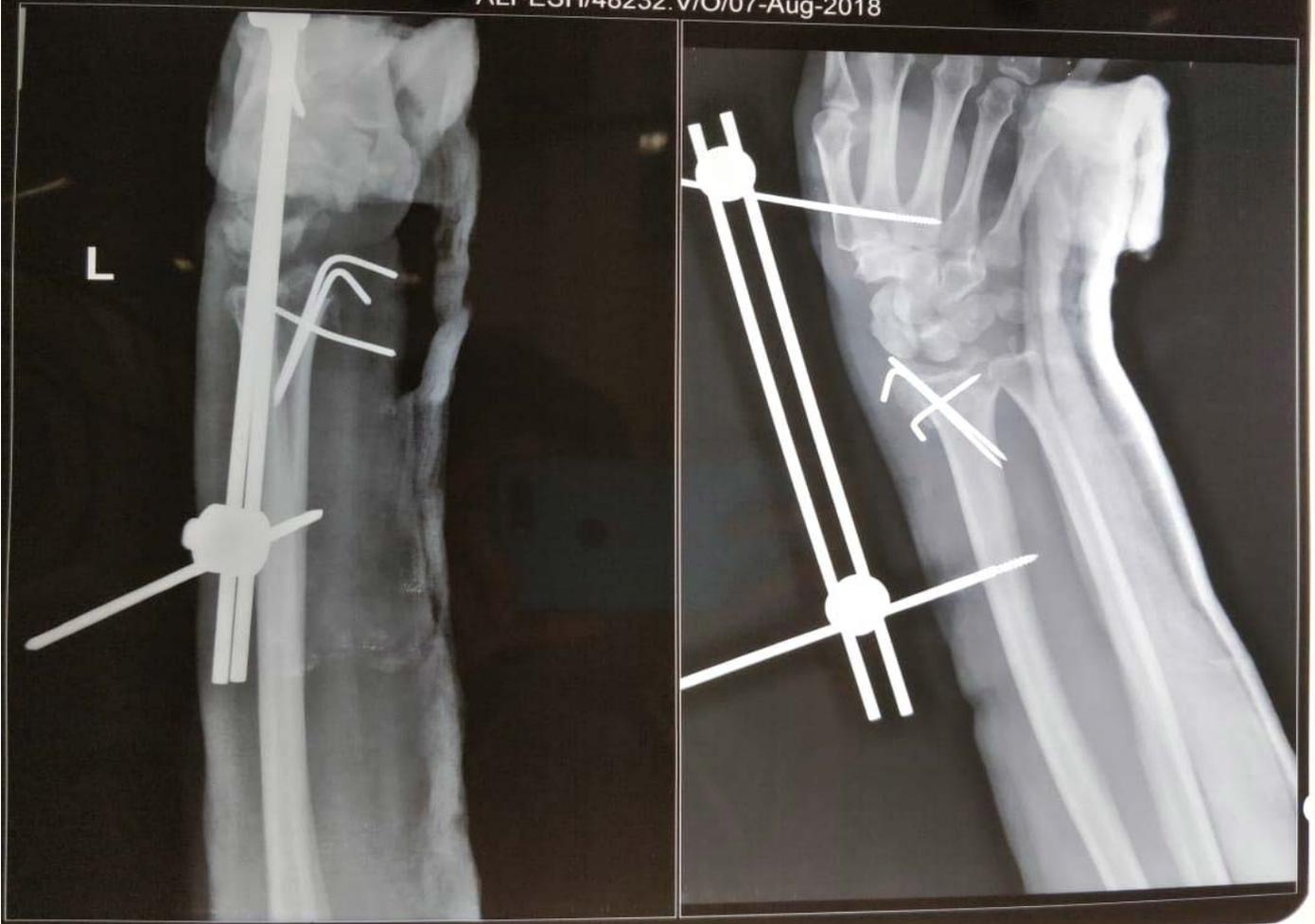
Forearm is kept elevated for 24 hrs and active finger, elbow and shoulder movements were started. I.V antibiotics, antacids and I.M analgesics were given in the immediate postoperative period followed by oral medication for another 5 days. Pin tract care was explained to the patient. The patient is encouraged to use the effected hand for daily activities within the permissible limits of pain. Most of the patients were discharged on 2nd or 3rd post-op day. Patients were reviewed after 2 week for suture removal, radiological assesment. In case of any collapse at the fracture site, distraction is adjusted accordingly. Supplemental K-wires were removed at 3 weeks. Assessment for radiological fracture healing was done at 3 and 6 weeks and most of the external fixators were removed at 6th post-op week and monitored physiotherapy was started. Further review was done at 3

and 6 months [Fig-2] and all the data was collected using a standard proforma.

[Fig-2]:

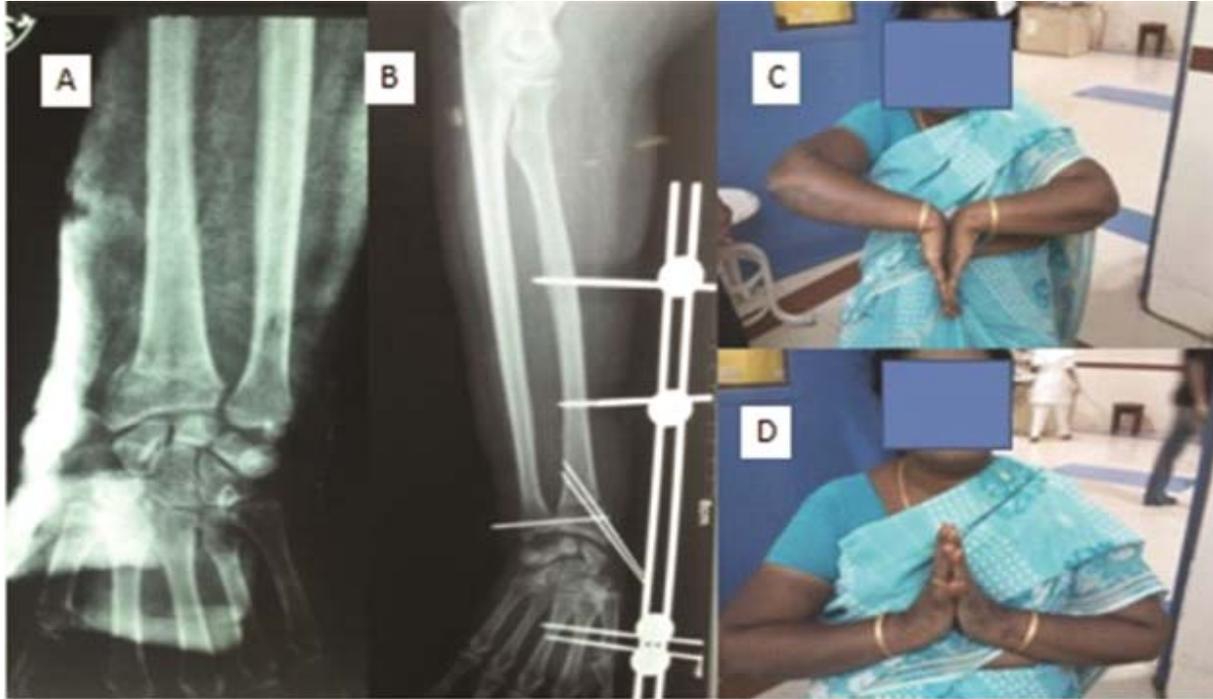


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(a)Pre op X-Ray

(b)Immediate Post op X-Ray



(c,d) 3 months Post-op clinical photograph showing unrestricted range of motion of left wrist.

[Fig-3]:

Sequential Pre-op, Intra-op and Post-op pictures of 2 patients: (a,b) showing comminuted distal radial fracture treated by bridging external fixator with acceptable reduction.



Results

In our study 24 cases were included and all of them were followed up for an average period of 9 months. 71% (17 of 24 cases) of patients were above 40 years of age and the mean age of the study population was 51 years (range 18 years to 65 years), 13 (54.16%) were male and 11 (45.84%) were female. The right wrist was involved in 54.16% (13 cases) and the left in 45.84% (11 cases), 19 cases (79.16%) were closed and 5 cases (20.84%) were open fractures. 38.4% of our cases were with complex intraarticular fractures i.e. Frykman type VII and VIII. Number of cases due to road traffic accidents was 61.53% and 38.47% were due to falls.

Most of our cases were treated with external fixator on day 1 within 6 hours of injury (range 4 hours to 3 days). Fixator was removed after 6 weeks followed by hot paraffin wax bath and physiotherapy. The follow-up period averaged 9 months, highest being 18 months and the least being 6 months. In 80.76% of cases radiological union was noticed in 6-8 weeks. One case had complex regional pain syndrome which resolved in 2 months with rigorous physical therapy and medication. One case had superficial pin tract infection which resolved with local wound care and antibiotics. Three cases (12.5%) had wrist stiffness. Marked improvement was seen after two weeks of physiotherapy. Malunion was seen in 2 cases (8.33%), which was primarily due to inability to correct the dorsal angulation.

Modified demerit point system of Gartland and Werley was used to evaluate the overall functional results [Table-3]- Master Chart.⁽¹⁰⁾ Excellent to good result was achieved in 87.5% of our cases while fair result was achieved in 12.5 % of cases of which 1case had pin tract infection/loosening and the other 2 cases had malunion. There were no cases with Poor results in the present study.

[Table-3]: Master chart/functional outcome

NO	Age	Sex	Side	Mode of injury	Frykman's classification	Closed/Compound Gartland grade- (Gr)	Trauma to treatment time	Treatment used	Duration of external fixator	Complications	Gartland and Werley score	Result
1	60	F	L	Fall (D)	II	Closed	2 days	K-wire + Ex-fix	6wks	–	6	Good
2	45	M	L	RTA	VII	Gr-I	12 hours	Ex-fix	6wks	–	5	Good
3	29	M	L	RTA	III	Gr-I	5 hours	K-wire + Ex-fix	6wks	–	4	Good
4	48	F	R	RTA	I	Closed	10 hours	Ex-fix	6wks	Stiffness-resolved	6	Good
5	68	F	L	Fall (D)	VII	Closed	3 days	K-wire + Ex-fix	6wks	–	5	Good
6	42	M	R	RTA	VII	Gr-II	6 hours	Ex-fix	6wks	–	5	Good
7	50	F	L	Fall (D)	I	Closed	10 hours	K-wire + Ex-fix	6wks	–	4	Good
8	37	M	R	RTA	V	Closed	6 hours	Ex-fix	6wks	Malunion	9	Fair
9	63	M	R	RTA	VII	Gr-I	8 hours	K-wire + Ex-fix	6wks	RSD, Malunion	10	Fair
10	64	F	R	Fall (D)	III	Closed	3 days	Ex-fix	7wks	Stiffness-resolved	6	Good
11	49	F	L	Fall (D)	I	Closed	10 hours	Ex-fix	6wks	–	2	Excellent
12	36	M	R	Sports injury	VII	Closed	2 days	K-wire + Ex-fix	6wks	–	6	Good
13	52	F	R	RTA	VII	Gr-I	8 hours	Ex-fix	6wks	–	2	Excellent

14	54	M	R	RTA	VI	Closed	4	K-wire	6wks	-	4	Good
							hours	+ Ex-fix				
15	62	F	R	Fall	III	Closed	12	Ex-fix	6wks	-	4	Good
				(D)			hours					
16	52	M	L	Fall	VII	Closed	2	Ex-fix	6wks	-	4	Good
				(D)			days					
17	23	M	R	RTA	VII	Closed	5	K-wire	6wks	-	2	Excellent
							hours	+ Ex-fix				
18	53	F	R	Fall	VI	Closed	8	Ex-fix	6wks	-	5	Good
				(D)			hours					
19	62	M	I	RTA	VIII	Closed	6	K-wire	7wks	Pin	9	Fair
							hours	+ Ex-fix		infection		
20	52	F	R	RTA	VI	Closed	10	Ex-fix	6wks	-	2	Excellent
							hours					
21	19	M	L	RTA	VI	Gr-I	6	Ex-fix	6wks	Stifness-r	6	Good
							hours			esolved		
22	70	M	R	RTA	II	Closed	12	K-wire	6wks	-	2	Excellent
							hours	+ Ex-fix				
23	34	M	L	RTA	II	Gr-I	8	K-wire	6wks	-	5	Good
							hours	+ Ex-fix				
24	43	F	L	Fall	III	Closed	8	Ex-fix	6wks	-	2	Excellent
				(D)			hours					

Discussion

Distal end of radius fractures are one of the common fractures managed by an orthopaedic surgeon.⁽¹¹⁾ Treatment outcomes are not uniformly good irrespective of the treatment modality. Number of studies have proved that there is a strong relationship between the quality of anatomical reconstruction and long term functional outcome.⁽¹²⁻¹⁸⁾

The A.O external fixator provides a simple and a reliable means of treating these fractures, especially unstable intraarticular fractures according to the concept of Ligamentotaxis that was proposed by Vidal et al;⁽¹⁹⁾ It uses the principle of distraction of intact ligaments in a complex comminuted scenario to bring back the fragments in place and hold them in position till the fracture unites.

If adequate closed reduction can be obtained, external fixator maintains the

reduction with constant distraction of ligaments which hold the fracture fragments in place until solid union occurs. Biomechanical studies by Nakata et al; revealed that A.O devices resist axial loading better in comparison to most of the other fixators.⁽²⁰⁾ Brinker et al; showed better resistance to axial loading with two rows of interconnecting bars.⁽²¹⁾ In the present study the average time of union was 7.2 weeks which is comparable with other studies. The comparative statistics of functional outcome in distal radial fractures managed by various methods can be seen in [Table-4].

[Table-4]: Comparative statistics of functional outcome.

S. No	Name of Series	Modality of treatment	No of cases	Functional result (Good to Excellent)	Functional result (Fair to poor)
1	Dowling and sawyer; (22)	Per cutaneousPinning	51	84%	16%
2	Cooney et al; (23)	Roger Anderson frame	60	87%	13%
3	Jakim I et al; (24)	Hoff-mann vidal frame	132	83%	17%
4	Present study	A.O*	24	87.5%	12.5%

*Arbeitsgemeinschaft fur Osteosynthesefragen

Apart from the above, plate osteosynthesis in osteoporotic comminuted fractures (barring Bartons fractures and fracture dislocations) is technically demanding, costly and often demands additional bone grafting with the necessity of second surgery to remove the implants at a later date.⁽²⁵⁾ In case of difficult intraarticular reductions minimal access fragment reduction and maintenance with K wires augmented with external fixation appears to be advantageous in comparison to the fragment devitalising conventional open plating and 10 times costlier fragment specific plating systems. Bridging external fixator with ligamentotaxis is cost effective and has a distinct advantage over the other modalities mentioned above in complex intraarticular and comminuted extra articular fractures of the distal end of radius.

Satisfactory results in this study may be attributed to the recognition and

definition of unstable injury at the initial assessment, careful patient selection, simplicity of the technique, careful postoperative management and aggressive early rehabilitation. It appears that the improved anatomical restoration with early rehabilitation does produce favourable functional outcome and the same is concurrent with the existing literature in this regard.

Conclusion

The external fixator using "Principle of Ligamentotaxis" for unstable and complex extra-articular distal end radius fractures is a simple device which is easy and safe to use even under regional anaesthesia with the distinct advantage of superior mechanical efficiency and capacity of fracture adjustment during healing period and aids access to wounds in cases of open fractures.

The shorter period of surgery, less tourniquet time, minimal exposure are its distinct advantages over plate fixation. It can be performed in emergency with less instrumentation and even when patient has swelling. Early mobilization also leads to less chances of wrist and finger stiffness.

Large number cases and follow up for longer duration could have yield better outcomes.

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